DOCUMENT RESUME

ED 099 192 95 SE 017 054

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TITLE Environmental Studies: Five Miscellaneous Reports. Project Reports, Volume 7, The Rachel Carson Project.
INSTITUTION Corvallis School District 509J, Oreg.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Office of Environmental Education.
BUREAU NO BR-1-0839
PUB DATE Sep 72
GRANT OEG-0-71-4623
NOTE 52p.; Related documents are SE 017 047-053

EDRS PRICE MF-$0.75 HC-$3.15 PLUS POSTAGE
DESCRIPTORS Conservation Education; Curriculum Guides; Ecology; *Environmental Education; *Instructional Materials; *Interdisciplinary Approach; Learning Activities; Natural Resources; Pollution; *Program Content; *Secondary Education; Teaching Guides; Units of Study (Subject Fields)
IDENTIFIERS *Rachel Carson Project

ABSTRACT

This document is the last of seven volumes included in the Rachel Carson Project. The project attempts to introduce environmental education lessons and units into existing courses of study within a high school curriculum rather than to implement environmental education through the introduction of new courses. Included in this volume is a report demonstrating methods by which environmental education can be implemented in a course on futuristics, an illustration of cooperation between a segment of the community (specifically a conservation organization) and a high school biology class which provides environmental learning experiences for both groups, an extracurricular project involving the study of a nearby creek as a potential spawning site for anadramous fishes, a proposal to utilize industrial waste material for projects in a high school industrial arts class, and a paper developed specifically for the project by an agricultural economist concerning the economics of environmental quality. Descriptions of the projects, lists of available resource materials, and suggested study outlines are among the contents of the various reports. (MLB)

School District 509J
Corvallis, Oregon 97330

ENVIRONMENTAL STUDIES: FIVE MISCELLANEOUS REPORTS

Project Reports, Volume VII
The Rachel Carson Project
USOE Project No. 1-0839
Grant No. OEG-0-71-4623

R. Thomas Tanner, Director

September, 1972

The research reported herein was performed pursuant to a grant with the U.S. Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

This volume is one of seven which constitute appendices to the "Operating Manual for Rachel Carson High," final report to the U.S. Office of Education, U.S.O.E. grant number OEG-0-71-4623. That report describes the Rachel Carson Project, which was supported by a grant from the Office of Environmental Education of the U.S.O.E. The Project was an attempt to pervade the existing curriculum of a high school with environmental education, with participation by faculty members representing many (ideally all) disciplines.

The project was based upon the philosophy that a positive environmental ethic should pervade our culture subtly but powerfully, just as - some people would say - materialism or pragmatism now do. Perhaps the best way to encourage the new ethic through formal education is to pervade the culture of the school, subtly but powerfully, rather than to establish a single new course such as "Man and Environment" or "The Environmental Ethic." (Note that the American public school does not offer courses in "Materialism" or "Pragmatism" - enculturation to these values, if indeed it occurs, is via more subtle means.)

This philosophy at work was exemplified by the present writer in an article extitled "A Day At Rachel Carson High," which appeared in the Phi Delta Kappan in March, 1970 (vol. 52, no. 7, pp. 399-401). The article follows a boy through one day at the fictitious Carson High. On this day: his chemistry class is dealing with the chemistry of the internal combustion engine and its emissions as they interact with biota; his English class is discussing the novel The Roots of Heaven, about one man's war against ivory hunters; his physical education class is examining various outdoor recreational activities and the degree to which they do or do not interfere with the activities of others; his American problems class is reviewing old American values such as freedom and equality before the law, and discussing the kind of physical environment in which they can best be popularly achieved.

On this particular day, classes are shortened so that teachers may have one of their regular planning meetings, the object of which is to facilitate the planning of their courses around such themes as:

Tomorrow's Technology and Today's License. (Rapaciousness toward natural resources is frequently excused with the rationale that tomorrow's as-yet-undeveloped technology can restore or offer satisfactory substitutes for those resources. This is a dangerous and irresponsible fallacy.)

Man in Nature, Man over Nature. (The belief that we can conquer nature has traditionally pervaded our culture - another dangerous fallacy.)*

*The reader may wish to refer to other themes and concepts underlying the project. Various of these have been elucidated by the present writer in articles in: The Science Teacher (April 1969, pp. 32-34; April 1972, pp. 12-14; Phi Delta Kappan (March 1970, pp. 353-356); Environmental Education (Summer 1971, pp. 34-37); AIBS Education Division News (August 1972). See also Hawkins, Mary E. (editor), Vital Views of the Environment, National Science Teachers Association, 1971, for an excellent selection of important concepts explained in brief articles by highly qualified authors. We have found this volume useful.

At the fictional Carson High, more or less standard course titles are retained, but each course includes lessons or units reflecting themes such as those above. During the 1971-72 school year, we attempted to implement this model at the new Crescent Valley High School in Corvallis, although some of our work was also done in Corva. .is High School, for reasons discussed in the body of our final report.

Participation was sufficiently wide and diverse as to include classes in typing, modern foreign languages, home economics, industrial arts, drivers' training, English, the natural and social sciences, and mathematics, as well as so-called extra-curricular activities. As noted earlier, this volume is one of seven, largely teacher-written, which describe the lessons and units developed during our brief experiment in curriculum innovation.

We hope that the Rachel Carson idea and at least some of these mat. .ls will be found worthy of emulation elsewhere.

We wish to thank all of those who participated in the project, and we especially wish to thank Dr. Clarence D. Kron, now Chairman of the Department of Education at the new University of Texas of the Permian Basin in Odessa. As Superintendent of Corvallis Schools, he offered the unfailing support which made the project possible. We are confident that vision and dedication will continue to characterize his performance at his new position, as was true here. We wish to thank also our new Superintendent, Dr. Thomas D. Wogaman, for continuing to provide an atmosphere congenial to our work during its final stages.

The titles of the report and the seven accompanying volumes are as follows:

Main Report: OPERATING MANUAL FOR RACHEL CARSON HIGH

Accompanying Volumes:

I. MAN AND NATURE - A LITERATURE COURSE
II. THE AMERICAN AND HIS ENVIRONMENT - A SOCIAL SCIENCES COURSE
III. ENVIRONMENTAL STUDIES IN THE PHYSICAL SCIENCES
IV. ENVIRONMENTAL STUDIES IN SEVERAL SCIENCE COURSES
V. CASE STUDIES OF CONSERVATION "BATTLES"
VI. ENVIRONMENTAL STUDIES IN NINE COURSES AT CRESCENT VALLEY HIGH
VII. ENVIRONMENTAL STUDIES: FIVE MISCELLANEOUS REPORTS

R. Thomas Tanner, Director, The Rachel Carson Project

Cispus Environmental Learning Center
Randle, Washington 98377
September 23, 1972

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Futurology

by

Karen Christianson

Editor's Note: This year Mrs. Christianson initiated a nine-weeks' course in futuristics, and agreed to place a special emphasis upon environment therein. The project director was especially anxious to have appropriate study of futuristics represented in the project. This is because all visions of the future are dependent upon an earth system having a finite supply of material resources, and are dependent also upon energy production which, to date, depends heavily upon the exhaustion of certain of those materials, i.e., the fossil fuels. Yet many futurist predictions of recent years seem to be oblivious to these constraints, or to be dependent upon technological breakthroughs which may or may not happen. The views of noted futurists are worthy of consideration and criticism. Buckminster Fuller, for instance, is keenly aware of our need to maintain a Spaceship Earth system in dynamic equilibrium, and is very optimistic about the potential of our remaining material resources to sustain a large earth population (We hope he is correct). Yet one might be legitimately concerned about the esthetics of a densely populated earth, however affluent and well-fed the citizenry. The same is true of Doxiadis' view of Ecumenopolis, the global city whose size and population density repel the present writer. Recent research sponsored by the Club of Rome have stirred popular controversy regarding the adequacy of computer modeling of alternative futures, and the assumptions regarding technological breakthroughs which underly the model-maker's inputs.

Mrs. Christianson's class necessarily dealt with ecological-environmental considerations throughout, but especially during a two-and-a-half-week unit called "The Environment and the Future." While the unit certainly does not deal with the full scope of concepts and authors suggested above, it does deal with some appropriate topics in an appropriate manner.

Having the class list characteristics which they wish to see retained in their own community seems a particularly good device for entre' into any number of subsequent activities which teachers and students might choose to pursue.

Unit: The Environment and the Future

Futurology is a nine-week course, with seniors of all ability and reading levels enrolled, as alternative for their Modern Problems requirement.

Assigned readings included selections from Future Shock, by Alvin Toffler; Alternative Futures for America II, by Robert Theobald; The Meaning of the Twentieth Century, by Kenneth Boulding, and articles from newspapers and magazines. Discussions on the basis of these readings were the major class activity. In addition, films, speakers, oral reports, demonstrations and role playing were integrated into the class activities. Throughout the course, but especially during the environmental unit, we stressed: 1) The present direction of American society--i.e., population patterns, mobility, abundance of wealth and resources. 2) Possible desirable goals for America--i.e., the quality of life. 3) The relationship between goals and political and private decisions--are we taking the right steps to improve the quality of life?

Major Unit Concepts:

1. Technology and cybernation can work to benefit man.

2. Man has the ability to create a desirable future through the contolled management of environmental resources.

3. Developed nations have responsiblities for the quality of life throughout the world.

Unit Outline (Approximately 2½ weeks)

I. The Land

   A. Alternative uses for the land
   B. Urban growth trends
   C. Corvallis: present land use and future goals.

II. Population

   A. Definition of over-population
   B. Population growth as a factor in economic development
   C. United States in a world role
   D. Population growth and the individual
      1. Job shortages
      2. Family pattern changes
      3. Effect on life styles

III. Entropy: Meeting the Future

   A. Definition of entropy in sociological terms
   B. Can we make it to the Twenty-first century?
   C. Evaluating technology

During this unit five group presentations were made by students. They were on the guaranteed annual income, mass transportation, new cities and towns, houses for the future and new roles for women. The guaranteed annual income group used role playing to present their ideas. They portrayed a panel moderator, a rich businessman, a college professor, a welfare recipient and a person about to be displaced by automation. Through this presentation they defined guaranteed annual income and presented major arguments for and against this program. The moderator controlled the discussion and fielded questions from the class.

A student in a fourth-year drafting class was invited to present his complete design for renewing downtown Corvallis. Architectural magazines enriched this presentation by showing what might happen in cities if the population trends continue. Underground cities, "apartments" to house one million people and cities over the oceans might become the reality for tomorrow. The inter-disciplinary aspects of this presentation were good because it linked theory to reality. Other students displayed new designs in housing which would minimize the space required for a home as well as maximize individual privacy. Students investigating mass transit decided upon electric mini-buses as a solution to traffic congestion and automobile pollution. They related their findings to small towns as well as metropolitan areas.

The most controversial discussion was on the future roles for women. The controversy centered upon the liberation of women and self-actualization as opposed to the traditional role definitions of wife and mother.

Conclusions

This unit has several advantages as well as disadvantages. The greatest disadvantage was the high level of the available reading materials. Many of the concepts presented by the authors were complex and controversial. In addition to this, Kenneth Boulding had a very difficult style for most high school students to comprehend. This was not as much of a problem in reading Robert Theobald and Alvin Toffler.

Student involvement was the strongest point of the unit. Ideas could be related to students interests that varied from auto mechanics to washing dishes. Discussion examples were easily drawn from many areas.

Mr. Adams, the Corvallis City Planner, was an excellent speaker who interested several students in projects dealing with land use in the immediate area. They became interested in the Marys' River and Willamette River reclamation projects as well as in local zoning to preserve green belts and the beauty of our surrounding hills.

This particular class did an excellent job in discussions. They had the ability to listen and respond to one another with very little teacher direction. This was an aspect that had to be considered in devising lesson plans and would have to be altered for individual classes.

Although it was almost impossible for the entire class to agree upon specific environmental goals, they did benefit from discussing a range

of alternative proposals. They were exposed to many approaches in defining and solving our problems. All of the students agreed that there were no easy or absolute answers for complex problems such as over-population, hunger, pollution and our diminishing natural resource reserves.

THE FINLEY WILDLIFE REFUGE PROGRAM

by

Christopher Carey,
Wayne Logan,
Wayne Bowers,
and
William Harris

Editor's Note: This report illustrates the kind of cooperation--between school and other segments of the community--which has consistently been encouraged by the Environmental Office of the U. S. Office of Education.

After the initial arrangements were made among Fin and Antler, Izaak Walton, and the Corvallis Schools, the Project Director met with Mr. Chris Carey to:

1. encourage him to urge participation by the biology classes at Crescent Valley High School,

2. offer complete financial support for field trip(s) by these classes, to augment the assistance from the Izaak Walton group.

The project director also met several times with the C.V.H.S. biology teacher to encourage his participation.

The project director was also fortunate to be able to encourage development of the Finley Program by offering at least a limited amount of university credit to the four young men above, in consideration of the substantial work they did.

It is interesting to note the learning experience as educators which these four had, since they are not education majors: for instance, Chris Carey's evolution from a "teller" to an "asker," as evidenced by his "personal" outline; or, that which the others learned about maturity levels and the corollary effect upon learning and behavior.

Editor's Note, continued:

This report, excerpted from individual reports by the four authors, is divided into two parts: (1) General Procedure and Evaluation, and (2) The Crescent Valley Field Trip and Evaluation. At the risk of a measure of redundancy, three descriptions of the C.V.H.S. participation are included, because of the sometimes contrasting observations by the three writers.

It will be obvious to the experienced teacher that the writers bit off quite a chew of subject-matter in preparing a one-hour preview for the students. Presumably, this also provided them a learning experience.

I. GENERAL PROCEDURE, AND EVALUATION

The Conservation Education Committee of the Fin and Antler Club has, during the past 2½ years, been engaged in a program of presenting to the Corvallis Public Schools a series of talks designed to create a degree of environmental awareness in school children. The students comprising this committee are, for the most part, students in the Department of Fisheries and Wildlife, at Oregon State University. It is a volunteer organization, with the members giving whatever spare time they have available. The talks offered included, Biological Pollution, Natural History of Wildlife, Endangered Species, Land and Water Ethics, and the Wonder of Birds. This past spring term our individual talk program was terminated and in its place a program was developed out in Finley National Wildlife Refuge, to which we took students of the Corvallis School District.

The "Finley Program" grew out of a meeting during winter term with Dick Rogers, Education Committee Chairman of the Corvallis Chapter of the Izaak Walton League. He told us that the Izaak Walton League had planned to allocate some $200 to provide bus transportation, so that school kids could partake in an "outdoor experience." They felt that existing school expenditures were not available for this purpose and that it would be in the community interest that these funds be made available. But rather than the Izaak Walton League developing a program, Mr. Rogers, at one of our committee meetings, asked us if we would be interested in developing such a program with their financial backing.

.....C. C.

When planning the program, we visited the refuge and talked to Mr. Rogers, Refuge Manager, to determine exactly where we would conduct the field trips. After visiting two trails we decided that the Poison Oak Trail would be better for our situation. The trail was well maintained, and there was little chance of someone becoming lost along it. The trail was in a loop so we would not have to backtrack at any time. It passed through several distinct community types, with a small pond nearby. From one hilltop we could view much of the refuge. Prior to taking the first group on the tour we made a tentative outline for all leaders to use as a basis for their presentation to the classes.

The first classes we led were fifth and sixth graders. We started with younger students in order to develop our program and build our confidence in our presentations. The groups usually ranged from 24 to 64 children, so we divided them into the smallest possible groups, depending upon the number of leaders available that day. The individual groups included 8 to 12 students each. I took one group of 4 children and one group of 16 children. With 16 children it was almost impossible to keep them all near enough to be heard, especially for the younger students. Although the younger age groups were more difficult to handle, they were no less enthusiastic than the older, more-educated high school students. Having too many students in the older age groups limited the number of questions that could be asked and answered. In the future perhaps a maximum number of students per group should be established,

varying with the age level. This would free the group leader from "policing" the students and give the students a more equal chance to ask questions..... W. L.

As our first "outing" was fast-approaching, we made copies of my first outline for those taking a group of students. Our first group was composed of about 50 sixth graders. Each Conservation-Education volunteer guided approximately ten students around "The Loop." The students were very interested and inquisitive--for about an hour. As the walk takes about 1½ to 2 hours, the latter part of the trip found the students easily distracted and worrying about getting back to the bus for lunch. Yet the Conservation-Education Committee felt we had met with some success. We had found that by adding a few items to our talks, by comparing items with things familiar to sixth graders, by deleting some of the technical jargon, and by allowing the students to eat lunch before leaving, our talks would probably be more suited to sixth graders. I adjusted my talks accordingly.

The main thing our one seventh grade group taught us was that the worth of our program depended greatly on the age-group involved. Although the students were generally well-behaved, they exhibited little or no interest in anything other than themselves and their peers.

.....W. H.

To make the Finley program possible, we needed an outline with which we could work confidently and comfortably. The original outline was good. It was complete and it lent itself to being easily adaptable to any age level. But I felt it made our talks "text book structured". By this I mean there were specific things to consider while at a particular place. It appears to be more of a reinforcement that the instructor knows what he's talking about, rather than an aid to help the kids benefit by what they're seeing.

One thing I've observed while being engaged in talks before school kids is that they will tolerate, up to a point, being told things. And I suppose the longer they can tolerate being told things the better schools have gotten through to them. But I don't feel the results are commensurate with the time and effort involved. Kids are told to do things at home, and should be asked what they think at school. And it is upon this logic that I base the outline I developed.

.....When I developed it, I went on the assumption that kids don't mind telling you what they know. And along with the old assumption that "you learn best when interested", I designed the outline as an observational guide. It was my hope to make the kids stop and observe what was happening around them, and to collect their thoughts. I really don't care how much they learn or remember, but rather I want them to be able to critically look at an area and be able to see or possible better understand relationships which go into making up the world. It is not a strong biological outline. The questions asked could be asked of other world occurrences". For example, #5, "Can you find any moss? algae? lichen? Where do they grow and how do they get their food? Why are some green while others are white?" The same question could be asked on a field trip through Portland, "Can you find any black people, white people or

brown people? Where do they live and how do they make a living? Why do some have jobs while others are on welfare?" It is a humanistic approach to biology, stressing observation of relationships rather than the learning of facts.

Once again I find myself becoming a little idealistic, but in general I found the outline was workable. There were, however, a few matters to be dealt with before starting. One was discipline. I hate to administer discipline, but on an outdoor field trip, kids become easily excited and like to shout and scream, run up and down the trail and tend to become an all-round hassle. But I found that discipline doesn't distract from the program as long as it's not overly directed at a few individuals but rather at the group in general. And the kids don't mind being disciplined, I suppose they're used to it. In difference to my previous notions, they don't harbor a grudge just because you spoke firmly to them. And, of course, like most educational circumstances, the smaller the group, the more effective one could feel.

My major criticism of the outline is that in a group, it tends to favor those few kids who are willing to speak their minds. I think this can be partly overcome by putting a few of the quiet ones "on-the-spot"--but while this may work, it may also alienate the student and cause some of the others to become disinterested. It's also hard for many kids to approach a subject this way, they're so used to being told facts. Some of the suggestions Mr. Bill Corcoran, of Harding School, made were very helpful. He suggested that we send around a glossary of terms or a brief guide so that the teachers could become familiar with what we were going to cover and thus prepare the kids a little. It's something to think about for the future. .....C. C.

Original Outline for Field Lectures to Public School Children; to be Correlated with the Poison Oak Loop on the Finley Refuge.

I. At beginning of trail.

A. Poison oak warning.
B. Refuge, but not untouched by man.
1. Logging
2. Farming and grazing
3. Habitat manipulation
C. Land is being used more carefully now, since it belongs to the public.
1. Not overgrazed. Why?
2. No more buildings and roads than necessary.

II. Creek

A. Erosion
1. From overgrazing.
2. From logging
B. Most erosion here is from previous land use.

III. From creek to top of hill.

A. Tree types and their reasons for being here.
1. Moisture---dryness
2. North or south slope
3. Succession
B. Small plants and their significance.
C. Lichens and mosses.
D. Decaying logs--an ecosystem within an ecosystem.

IV. Upper bridge

A. Oregon ash and its significance.
B. Swamp or moisture-requiring plants.

V. Man-made lake.
A. Lakes can be examined like a decaying log--as a part or as a single ecosystem.
B. Wood duck nest--------
C. Other values of the pond, such as plant and animal uses and requirements.

VI. Edge cover on the down hill walk

A. What bird and mammal requirements are served by edge cover?
1. Food--predator/prey relationships
2. Shelter
3. Loafing area

VII. Summary

A. Outline the purposes and/or uses of this refuge.
B. Outline the refuge system--size, financing, magniture, purpose.

A summary topic may be necessary at the outset, to allow a diffusion of the individual groups of students.

My Personal Outline for Poison Oak Loop.....Christopher Carey

1. Always be looking and listening for:
   A. Small birds and their calls
   B. Different types of seeds
   C. Signs of animal and insect life
   D. Different types of plants
   E. The sounds of the out-of-doors.

2. In an area used for grazing, why is the undercover so thin? What type ("tree", "shrub", "vine", "herb") is poison oak? What other kinds of plants are present?

3. What causes erosion? What damage does it cause? Is this natural occurrence always bad?

4. What do you think happens to old buildings? Old logs? What appears to be the most "dominant" plant type here? Do you see any signs of wildlife? Insects? Worms? What kinds of plants grow here? Compare the ones in open sunshine, with those growing in the shade.

5. Can you find any moss? Alge? Lichens? Where do they grow and how do they get their food? Why are some green while others are white?

6. What is it about a decaying log that makes it a complete "Ecosystem"? Look for both plant and animal life. Does any of it resemble that which is growing on the ground?

7. When man's influence on an area is small, what type of plants begin to grow? Can you tell the difference between an "evergreen" and a "deciduous"? Is there a difference in the shape of their leaves.

8. Is there a difference in the type of plants in a marshy area? How dense is the plant cover? Can you find any signs of wildlife? Look for droppings, tracks, bird nests, browsed-upon plants.

9. In an aquatic environment, how do the plants differ from those we've seen on land? What type of wildlife can you find? What do you suppose this water is used for? Can you find the wood duck's nest?

10. Look out over the Willamette Valley. How much of man influence is evident? Why do you suppose there is a National Wildlife Refuge?

THE C.V.H.S. FIELD TRIP

May 5, 1972
School: Crescent Valley High School
Grades: 10th and 11th
Number of students: 35
Number of guides: 5

As this was our first group of high school age students, whom we thought might be more interested in the technical aspects of ecology, we decided to implement something that we had talked about for a long time. We decided to go to the classroom with a preparatory talk. Since the students who were going to the refuge met at two different times, the four of us divided into two prep groups. Christ and I went ou to the school for the morning briefing. Our briefing was on Wednesday and the trip to the refuge was on Friday.

At the briefing we reviewed the basics of ecology, clearing up definitions of words. We discussed the history of the refuge and the types of plants and animals that they could expect to see during the walk along the trail. The briefing lasted about 30 minutes so we could not cover too much.

On Friday, at the refuge, the students were divided into five groups with about eight students per group. My group was composed of 6 girls, 1 boy and 1 woman student teacher.

It was soon apparent after beginning on the trail, that the students were on about the same level of knowledge as the 4th, 5th, and 6th graders of the previous trips. There was a difference, however. The students seemed hesitant to really break down and talk. They were hesitant to speak up or ask a question. It seemed as if they were ashamed that they knew so little about the outdoors. I was disappointed as I thought high-school-age students would be more inquisitive. The only person who really seemed interested was the student teacher and one girl who had recently moved to Corvallis from California. She was the only one in the group who knew the state flower and could identify it. She also knew the state bird, animal, and tree.

Although I was disappointed in the lack of enthusiasm shown by my group, they were not uninterested and I think they enjoyed the hike.

I have learned from working with the younger age groups that there is a considerable difference in behavior between groups so I would not use these students as a measure of the typical high school group.

Unfortunately, we were short of time on this trip and everything was rushed, which is a factor to consider.

.....W. B.

When we organized the tour for the Crescent Valley High School biology class, we did go to the school and give a brief presentation two days before the trip. Bill Harris and I gave one of these presentations. Our outlines, which follow, overlap because we devised them separately but divided the presentation into two parts. Bill gave a brief description of the refuge and what we might see. I concluded with some of the terminology we would be using on the tour and a question and answer period. The presentation was very informal and seemed to draw good response. When we went to the field I did not lead the same group that I had spoken to at the high school. To build better rapport with the students and maintain continuity in the program, I would suggest that each group be assigned the same leader for the preview and the actual field trip.

On the high school tour, I conducted my trip in the opposite direction of all the other groups because I felt that we could get a better overall view of the area first. We went right to the top of the hill and viewed the entire refuge and the various communities that we would pass through on the rest of the tour. The history of the area is more obvious from this vantage point; the various communities are easily separated, and we had a little time just to stop and explain certain points. Unfortunately, time ran short on this day and I had to rush through the last half of the tour, so my comparison of the two directions was incomplete. I think committee members should study this aspect to determine the advantages or disadvantages of changing direction.

Also, with the younger groups I had tried several different types of groups--all boys, all girls, or mixed groups. Each group is so much different that you never know how they should be divided until halfway through the tour. One clown in the group can (and did) disrupt the whole group. The teacher is probably the best judge of how to divide the class. He knows the children and can put the "problem" kids in one group, if for no other reason than to make it easier for the other group leaders to handle the rest of the students.

I sincerely hope that this program will continue in the future. I found the tours to be fun and interesting. It was challenging to try to explain a small part of my education to these youngsters. When they asked questions I hoped this represented the interest of the younger generation in learning more about their world. If they remember just one small point that I explained to them, then it was worthwhile. As a graduating senior I will not be available to help out next year, but from this brief discussion, perhaps improvements will be made that will make this program a permanent feature in the wildlife and education field.

.....W. L.

Outline of

Introduction to Crescent Valley High School Field Trip

By Wayne Logan

I. Finley Wildlife Refuge History

- A. Established 1965
- B. Area: 5,322 acres
- C. Man's past influence
  1. Farming
  2. Logging
  3. Burning

II. Purpose of the Refuge

- A. Primary: Dusky Canada Goose (Branta Canadensis occidentalis)
- B. Secondary:
  1. Ducks
  2. Resident mammals
  3. Nature observation (important to emphasize that anyone is free to roam the refuge except during duck hunting and deer season.)

III. Trail we will visit

- A. Length: 1 mile
- B. Pathway up a hill (wet)
- C. Poison oak everywhere

IV. Brief review of ecological terminology used on the trip

- A. Ecology
- B. Ecosystem
- C. Biome
- D. Community
- E. Niche
- F. Diversity
- G. Ecotone
- H. Species
- I. Abiotic - environment
- J. Biotic - living organisms
- K. Succession
- L. Communities
- M. Series
- N. Climax
- O. Eutrophication

V. Points of interest
    A. Ruffed grouse drumming
    B. Deer nursery
    C. Identification of plants as indicators
VI. Range management tools
    A. Grazing cows
        1. Summer reduce fire hazard of dry grass
        2. Retard succession
    B. Water level control of marsh

We realized that it was fruitless to ignore maturity levels--so we turned to high school. We felt better qualified to work with high school students after our experience with elementary and junior high students. Ironically, working with high school students was much more rewarding--and worthwhile--than pre-high school students. Whereas the sixth and seventh graders viewed the program as somewhat of a "play-day;" the high school students seemed to view the trip as an opportunity to learn more of things which they were very much concerned about. Thus, our program became much more of a "teaching-learning-sharing" experience than a "baby-sitting" one.

Our committee thought it might be beneficial to talk to the students prior to taking them to the refuge. We arranged to talk to a group of high school students during their biology class at Crescent Valley High School. I prepared an outline for the talk. I attempted to explain the purpose of the trip, and prepare the students to look for certain things on the hike. Wayne Logan, who addressed the class with me, and I were pleased to find that the students were genuinely interested in our program. Their interest was shown in their many comments and questions. We soon became involved in a concerned discussion.

I felt our pre-talk was extremely helpful--not only to the students--but to me. I found that I could prepare a more meaningful talk by knowing what concerns are most prevalent among the group to which I was to talk. The pre-talk also reinforced my former conviction that the program was better suited to high school:

1) High school students seem to have a longer attention span than sixth and seventh graders.

2) High school students exhibit a greater interest and concern for the issues our program covers.

3) The issues our program deals with seem more "relevant" to high school students than to sixth or seventh graders.

4) The current high school curriculum better coincides with our program than that of the elementary schools.

By the time I had worked with three different age groups, using various presentations, I had formed a few conclusions other than that the program was best suited to high school. One such conclusion was that our program is not one that is found in the science or biology class today. Our program is one of general interest and concern--a "tying-together of things."

Throughout my work, it became increasingly apparent that we have a need for such a program in the public schools. I personally believe that we could justify a conservation-education course in our schools today.

.....W. H.

Outline of Presentation

by William Harris

IN THE CLASSROOM

I. Finley Wildlife Refuge
   A. Established in 1965
   B. 5,300 acres
   C. Purchased with Duck Stamp Monies

II. Plant Succession
   A. Long term
      -Lake---Swamp---Meadows---Shrubs---Trees---Climax forest.
      (or) Lake---Marsh---Prairie climax.
   B. Short term (or backward succession by an "act of God" or man)
      Fires, Logging, Farming
      1. Grasses and herbs
      2. Shrubs
      3. Mixed hardwoods
      4. Conifer climax
   C. Succession stages have a direct effect on animal species present.

III. Living Communities of the refuge area
   A. Plant
      1. Natural prairie
      2. Marsh
      3. Lowland
      4. Upland
   B. Animal
      1. Mammals
         a. Present in large numbers, but secretive in habits.
         b. No predator control (except wild house cats) on refuge.
      2. Birds
         a. Many species present--due to diversity of habitat available.
         b. Diversity of plant communities can be easily compared ecologically to the bird species diversity.
      3. Insects
      4. Reptiles

IV. Terminology
   Ecology, Ecosystem, Ecotone, Edge effect, Community, Climax, Succession

IN THE FIELD

Plant succession is pointed out in detail. Plant communities are pointed out and plants present are used as starting points for most other parts of discussion. For example:

I. Pollination of plants
    A. By insects
        1. Large flowers
        2. Brightly colored
        3. Fragrant odor
    B. By birds
        1. Sticky seeds
        2. Sticky pollen
    C. By wind
        1. Much pollen
        2. Inconspicuous flowers
        3. Tall

II. Plants as indicators
    A. Oregon ash--high water level year round.
    B. Poison oak--disturbed land from:
        1. Logging
        2. Overgrazing

III. Terminology is applied
    A. It is explained how a lake or a log can be an ecosystem.
    B. Ecotone areas are pointed out and discussed again.

Questions are encouraged and in the event I might be unable to answer them, I am prepared to direct the student to the proper literary source.

The Jackson Creek Project

by

Fred Woods

Editor's Note: This project began when, in late November or early December, Mr. Bill Saltzman of the Oregon State Game Commission suggested to the project director that Jackson Creek, which bisects campus, might have potential as a spawning site for anadramous fishes. He suggested that if the school were to "adopt" the stream as a study site for several years, making daily measures of such variables as height, flow, and temperature, the game commission could possibly use the data to advise on feasibility of the next phases, which would be stream alteration and control as necessary, followed by stocking of fishes.

On December 9 Mr. Saltzman met at CVHS with the project director, five teachers, and a student teacher. (Several students were invited but failed to appear - a general announcement to all students should have been made, at any rate.)

The teachers showed considerable enthusiasm, and two volunteered to obtain area maps and aerial photos with which they were familiar.

Some of these teachers retained more or less interest in the project through the remainder of the year, and were joined by others who took an active interest, especially Dick Moon in mathematics and Wayne Spletstoser, chemistry. They were assisted during winter term by Fred Woods, a fisheries graduate who was working in the school as a professional aide, as part of his work toward a teaching degree.

This project waned during the year for a variety of reasons, some of which can be inferred from Mr. Woods' paper. Though not a complete success, this extracurricular project is described here because:

1. It did lead some students to learn specific techniques of stream study.

2. It may be resurrected, given the seed that was planted, especially since no CVHS students this year were seniors, i.e. the participants will be in school at least one more year.

3. Mr. Woods' paper provides insights into the project dynamics.

The materials included herein are:

I. The notes distributed by Mr. Saltzman at our original meeting, December 9, 1971.

II. A front page article from the school newspaper, the Crescent Crier, of February 7, 1972.

III. Mr. Woods' narrative of March, 1972.

IV. Some publications useful for such a project.

I. Mr. Saltzman's Outline

Crescent Valley High School Study of Jackson Creek

Suggested Study Outline

1. Obtain large scale map(s) of Jackson Creek (ownership maps, from County Assessor)

2. Identify short term (Jan.-June 1972) and long range objectives of study.

   Suggested short term objectives:
   a. Develop task force to help identify goals and oversee pro-projects.
   b. Physical stream survey of Jackson Creek (stream width, depth, spawning and rearing areas, barriers to fish passage, adjacent land use, etc.)
   c. Water temperature measurements - possible use of thermograph.
   d. Water quality measurement - determine sampling sites, intensity, and parameters (consider dissolved oxygen, pH, turbidity)
   e. Sample fish population (Game Commission with backpack shocker). Determine total population - mark and recovery.
   f. Sample bottom organisms - quantitative and qualitative measurements.
   g. Measure streamflows by weir or other means.
   h. Consider local publicity - when and how local landowners, within CVHS as "our stream" etc., etc.

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11. From page 1, The Crescent Crier, February 7, 1972.

Creek research group formed

One of the many new organized groups on the Crescent Valley campus is the Creek Reserach Group. This group has been organized to enable any students to explore the fields of ecology as related to such fields as physics, history, biology, and even photography.

The teachers who are devoting their free time to the group are Mr. Jack Whitney, Mr. Dick Moon, Mr. Jay Kilborn, MR . Bill Buell, and Mrs. Nancy Holingshead. An aid from OSU has arrived to take over some of the work load, is Fred Woods and is a major in fish and wildlife. The group right now consists of the classes of the teachers mentioned above, but the teachers urge other students to take part.

Some of the groups activities are financed by the money granted to CVHS by the U.S. government with the understanding that is was to be used to battle pollution. The group will keep a log on all its accomplished, and hoping that in the future it will be kept up to date.

The group hasn't gotten into full swing yet and this is why you may not have heard of them yet, as soon as the teachers get the format set up other students may participate on any project they like.

The reason the group was organized was to show the students how the natural resources around our school must be taken care of and respected, plus show them how much they can do to keep up their natural beauty. Some of the projects that the group is looking at is the future is possibly stocking the flowing waters with some speces of fish. Mr. Dick Moon, one of the teachers involved in this effort to control pollution has said, "the log tht will be kept of the accomplishments made will hopefully be kept to someday be published as a book." Anyone wishing to get involved inthis project be sure to contact one of the teachers associated, you won't regret it.

III. Field Observation - The Jackson Creek Project

By Fred Woods, March 1972

The Jackson Creek project is a branch study of the Rachel Carson Project taking place at Crescent Valley High School. Its purpose is to encourage student participation and interest in a survey of the creek which flows through the campus. The project is probably aimed mainly along the lines of science and ecology; but any kind of general interest and participation are also encouraged. Some of the eventual practical goals of the project might be an analysis of the stream for potential domestic use, possible fishery establishment, and a log of stream data.

My job so far has been primarily organizational and "errand boy" in nature. I really haven't had to help students that much other than helping them obtain materials or outlining what we would like to see them do. I have attempted to locate and talked to most of the students signed up on the interest sheet. It has been very difficult to find many of the students during X-period though.

Generally I spent three to six hours per week at Crescent Valley during or close to X-period. Time was also spent on errands away from the school averaging the time out to about five hours per week. I can't honestly say that all of the time was productively aimed at the project, though. Often there was very little to do or students would be tied up in other activities, so I would just wander around "observing" students or sit in on a class.

Progress on the creek project has been very slow. At present there are about ten people working on projects and two or three others about ready to embark. An overabundance of data from projects still has not materialized. So far there are a few charts and a partially completed map. Also a student is working on a photographic study of the creek and is beginning to turn out a few prints. Other students working on projects have made test trials but have not obtained any data yet.

One of the biggest reasons for the lack of progress has been that the project is voluntary. When other activities come up or other studies play for time during X-period, the creek projects slip. Also when an activity involves work without grade or credit, incentive and motivation is lost.

Part of this problem is being solved by working the creek study in as projects in classes. At present I have talked to Molly Bonser in humanities, Wayne Spletstoser in chemistry and Jack Whitney and Jay Kilbourne in biology about the possibilities and they seemed to think it could be worked in. I also talked to Don Maye of the Water Resources Lab. He indicated that he would be able to give some lectures on analysis of water quality in early April.

There really isn't a great deal I can say about the kids working on the projects. Most of them know pretty much what they are doing and other

than needing some prodding now and then they have few problems and keep up on their projects.

Frank Felix, our photographer, was the first student I worked with. He had never developed his own pictures before this term. I think he has probably learned more and put more time into his project than most of the other kids.

Gerald and Sal measure stream height twice a day and record it on a chart. They fall behind once in awhile and mess up each other's recordings, but have a pretty complete record.

Charts of rainfall and temperature (water and air) are kept by Dean, Stan and Mark respectively. They are harder to get hold of to prod so their charts are not quite as complete.

The map of the creek, which has been slow in the making, is a group effort of Jeanie, Dick (Moon) and myself.

Stream flow measurements are the project of Steve and Larry. They have attempted to take measurements a couple of times, but finding enough time to use the equipment they have has not been adequate. They are both pretty intelligent kids though, and have been trying to design an apparatus that takes up less time to use.

Marsi and Jeff have indicated interest in water analysis and biological survey, but are still just "thinking" about a specific project.

Hopefully participation will pick up, if and when the project is extended into the classroom. Spring weather (?) may also get a few more kids out looking at the stream. I am sure many potential projects have remained potential because of the unattractiveness of a muddy stream bank and the cold, wet weather.

I think having a couple more teacher's aides on the project would help. Not only would it help to get some more ideas but it would help in carrying out the ideas. Several ideas have never materialized because, I felt I could not commit myself to the amount of time necessary to do the job. Also, due to my own organizational problems, when more than one idea or test was suggested, instead of deciding which one should take precedence, I would blunder into both and end up with little or nothing accomplished. Having more than one aide would help remedy this.

Projects I am working on for next term include:

1. Water quality study (Don Maye)
2. Biological survey - logging of native fauna and flora; fishery potential; ecosystem survey
3. Guest lectures and movies

I would also like to see the students take over the organizational aspects of the project or at least part of it. Maybe I should say, make an organization out of the project - something that will get the kids together and stimulate a little more interest. From observation it seems like kids are more interested when a group is involved, perhaps because of recognition.

IV. Some Useful Publications

A Curriculum Activities Guide to Water Pollution and Environmental Studies, 1971, Institute for Environmental Education, 2803 Scarborough Road, Cleveland Heights, Ohio 44118. $15.00 total for the two volumes.

Techniques field-tested in a well-known school project, the Tilton Project.

Stream Analysis ($1.00) and Water Quality ($1.00), Environmental Science Center, 5400 Glenwood Avenue, Minneapolis, Minnesota 55422.

A number of other titles available also:
Population Growth, The Cemetery as a Social Document, etc..

A Proposal for the Utilization of Industrial Waste Material by Corvallis Schools

by

George Perreard

Editor's Note: The industrial arts teacher who developed this proposal works at a school in our system other than Crescent Valley High School, but the project director has worked closely with him in developing and encouraging his proposal, which seems appropriate for presentation here. His efforts should effect C.V.H.S. as well as the other senior and junior high schools in the area.

At the time of this writing, Mr. Perreard is somewhat behind his proposed time line, chiefly due to the changeover of superintendents during June and the absence of the project director during much of June. However, he has now contacted several local businesses and our new superintendent, and has received positive response (as he did also from the former superintendent).

Incidentally, a "crab ring" is a device used in the Pacific Northwest for catching crabs, and is somewhat analogous to a lobster pot.

Introduction

The basis for this proposal is a concern for utilizing waste material from local industry for educational purposes, thereby saving natural resources, saving money spent for educational supplies, and further involving the community in the educational process.

There is wood, steel, plastic, aluminum, lead, copper, etc., in Corvallis, now being disposed of, which should be readily available to be used in our educational program. My Industrial Arts classes have experienced effective learning and constructed worthwhile projects utilizing waste material.

To date, there is no efficient way of collecting and utilizing these materials. Many teachers lack information as to their availability. No one individual can reach all the sources of waste material. Educators lack the time, transportation, and facilities to efficiently pick up and deliver these materials.

I would like to have the opportunity to attack these problems. Therefore, I am requesting the permission and authority from the Corvallis School District #509J, to implement the following proposal:

Proposal

I. Physical Needs:

A. Transporation--provided by School District #509J. Truck and driver to collect materials periodically.

B. Containers for collecting and separating waste materials to be left at cooperating businesses.
   1. 55 gallon barrels
   2. paint
   3. stencil

C. Paper--for communication purposes.

II. Timetable:

A. Spring Term 1972:

1. Contact all businesses in Corvallis that might be able to contribute usable waste materials. Give them lists of what materials could be used and in what ways. This might serve to open communications on use of materials. Secure permission from them to remove materials from their premises.

2. Discuss proposal with Corvallis Disposal Company; making them aware of our intentions.

3. Personally contact interested teachers, explaining how the proposal will work; thereby obtaining a workable list of interested teachers.

4. Send out a tentative list of available materials giving participating teachers time to think about which materials they could use to good advantage.

B. Summer 1972: I will, with the help of students, construct or secure, paint, and label containers to be used for collecting waste material from businesses.

C. Fall Term 1972:

1. Send lists of available material and request forms to interested teachers.

2. Compile returned requests and make a schedule for pick up and delivery, and a list of materials each cooperating business can supply.

3. Distribute labeled collection containers to cooperating businesses with a list of materials needed.

4. Arrange for pick-up and delivery of materials by District 509J, according to arranged schedule.

5. Solicit and compile additional ideas for uses of material and any new materials needed to be salvaged, thereby keeping an up-to-date program which is flexible enough to change with the needs of the teachers making use of the program. (I would guess that, at first, the students would use a wide range of materials, but, with experience, the requests would become more selective, thus conserving time and effort.

6. Keep close contact with participating businesses to iron out any problems which arise.

III. Long Range Plans: Proposal Evaluation

At the end of each school year, the amount and type of material salvaged, and how it was put to use in the educational system, could be recorded, with copies given to all individuals involved. This same report might also be published in the newspaper, in hopes of widdening support of the program by both teachers and businesses.

Posters, created by students, might also be used as advertisement and a way of making public, any materials still needed which might possibly be donated, thus further involving the community.

IV. Projects Completed to Date in my Classes, Using Salvaged Material:

A. Woodshop Projects:

1. small projects with soft woods and hardwoods
2. cutting boards
3. bookends
4. cider press
5. fence rails
6. book shelves
7. memo pad
8. key board
9. mallet
10. pieces of bandsaw practice and lathe practice
11. gun racks
12. candle
13. wood carving
14. napkin holder

B. Metal Shop Projects:

1. fireplace andirons or grates
2. dust pan
3. tool box
4. parts tray
5. vise pads
6. practice pieces for arc welding and gas welding
7. crab rings
8. garden hose hanger
9. cardboard binding jig
10. old bikes and lawn mowers for such classes
11. Aluminum scrap for casting in foundry
12. lead scrap for casting

C. Science Projects:

1. electro magnets
2. crystal radios
3. electric motors
4. telegraph
5. wet cell battery

The only limit to the projects constructed from salvaged materials are:

1. the available material, and
2. the imagination and ingenuity of the builder

THE ECONOMICS OF ENVIRONMENTAL QUALITY

by

Joe B. Stevens

Editor's Note: At the time our project began, it was suggested by staff of the Office of Environmental Education that an economist should provide consultation for participating social science teachers. Dr. Stevens was already known to us as an agricultural economist with a strong interest in environment and the environmental costs of economic growth, as a young man taking a leadership role in environmentally-related activities of Oregon State University. We were gratified that he and his department chairman, Dr. Emery Castle, agreed to his participation in the project. Dr. Stevens also kindly agreed to prepare this special paper for our final report.

The Economics of Environmental Quality[1]

by

Joe B. Stevens[2]

At extreme ends of the spectrum of today's environmental controversy are these two arguments:

1. There is really no environmental problem.
2. There are no feasible solutions to current environmental problems.

Most thoughtful and informed people would reject both of these extreme arguments. They could, and do, point to a variety of types of air pollution, water pollution, urban sprawl, chemical pollution and esthetic degradation as "problems" of environmental quality. As to "solutions," most people have some degree of confidence in their collective ability to resolve social problems. Thus, the assumption is made here that neither of the above polar arguments form a suitable context for gaining an understanding of environmental problems and solutions.

In the space between these polar arguments, however, lies room for reasonable people to disagree. Where disagreement exists, room exists for increased knowledge and understanding. This paper is an attempt to convey some basic understanding of the economic dimensions of current environmental problems.

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1. Technical Paper No. 3414, Oregon Agricultural Experiment Station. This paper is written as a capsule summary of the topic and is directed primarily as a guide to high school teachers in the area of environmental education. In that the author is not trained in secondary education methods, no attempt is made here to translate these concepts into curriculum development.

2. Associate Professor of Agricultural Economics, Oregon State University.

I. Definition of Terms:

Some insights can be gained by first examining the key words of the title, then by attempting to relate them to each other.

A. Economics:

It is most important to note some things that economics is not! "Economics" is not identical to the "marketplace," nor should it be identified solely with "monetary values." The marketplace is only one means that may be used for deciding what is to be produced and consumed. As an example, state education laws usually dictate that each person shall receive (and shall be forced to receive) at least an eighth or ninth grade education. Public educational policy has thus replaced the market mechanism in this area. Were it not for these laws, some people would take (or force or allow their children to take) less than the required education.

"Economics" is often defined in elementary college texts as "the allocation of scarce resources among competing uses." More accurately, it should be defined as the study of such allocations. Study, in this sense, need not be formal or take place in a classroom; it can be (and is) done by a businessman or legislator who tries to understand "what will happen to Variable A if Variable B changes."

Definition of economics in this manner allows one, then, to differentiate "economics" from the "economy." "Economics" refers to understanding of certain phenomena; the "economy" refers to a certain set of man-made institutions. The latter is defined by Kenneth Boulding (1) as "...that segment of the total social system which deals primarily with exchange and the institutions of exchange...". All production and consumption decisions are not resolved by the "economy," as noted above. In the U.S., however, we have historically relied on the marketplace to resolve many of these decisions: thus, an understanding of how the "economy" relates to our environment is central to understanding the current environmental crises.

B. The Environment and the Economy:

The concept of a "materials-balance" model is useful in explaining interactions between the "economy" and the "environment." Dr. A. Myrick Freeman's discussion of these interactions is excellent for presenting this concept (2):

> "Assume that all factories, mines, transportation systems, and so on, in the economic system can be represented by the box labeled "production sector" in Figure 1. Whatever is produced there goes to consumers who live in the "household" sector. The production and household sectors are surrounded by "the environment." Raw materials flow from the environment into consumer goods, and flow on to the household sector.

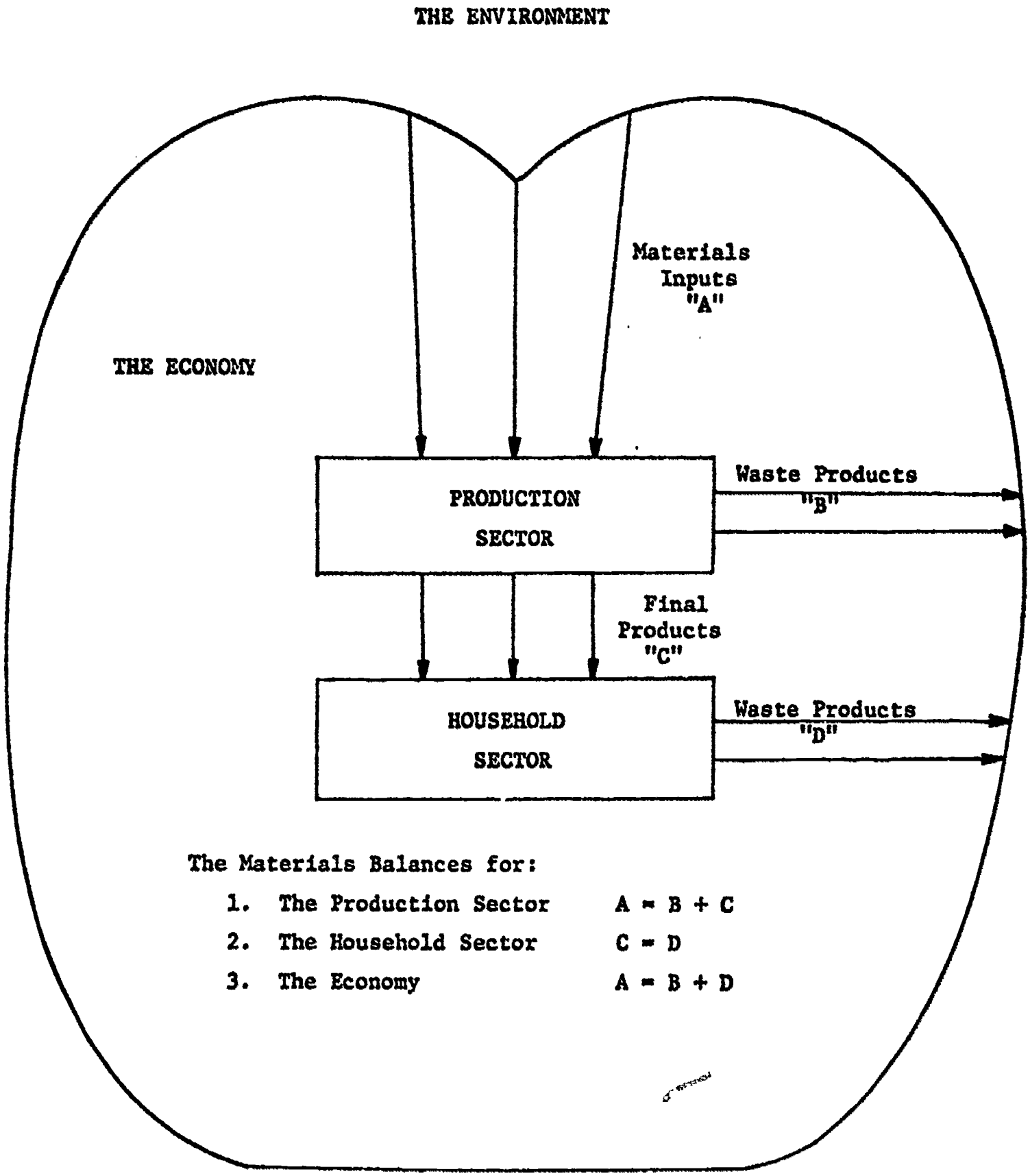

Figure 1.

Source: "The Economics of Pollution Control and Environmental Quality," A. Myrick Freeman, III, Bowdoin College, 1971 General Learning Corporation.

> The material flows must obey the basic laws of physics concerning the conservation of matter. For any sector in the economy the mass of materials flowing in must equal the mass of materials flowing out, unless there is an increase in the stock of inventories of materials held within the sector. This is the principle of materials balance. The process of production generates unwanted materials called wastes or residuals. Since these are not passed on to the household sector, they must either be accumulated within the production sector or transported back to the environment in some form. In the household sector as well, except to the extent that consumers accumulate durable goods, the input of consumer goods must ultimately be equaled by the output of residuals."

The implications of a materials-balance are fairly obvious, although economists have long failed to recognize them. The most basic implication is that there is no such thing as "consumption" in the sense that economists have used the production sector to the household sector are not consumed in a physical sense -- their form is merely changed! It would be far more accurate for economists to talk about the "consumption of services" than about the "consumption of goods." A used car physically deteriorates, but it is primarily the services offered by the car which have been consumed -- the motor sputters and the brakes are failing. The "goods" components of the auto are returned either to environment (e.g., the rubber tire tread) or to the production sector of the economy (e.g., the recycled auto).

C. Economics and the Environment:

"Economics" the study or understanding of resource allocation, can thus be differentiated from the "economy", a set of man-made institutions which facilitate exchange of goods and services. The "economy" has been shown to be related to the "environment" through a materials-balance model. What can be said, then, about the relationship between "economics" and the "environment"?

One way in which this question can be explored is through developing some additional concepts of economics. One such concept is the differentiation of "positive economics" from "normative economics." The first is strictly analytical, and constitutes the main body of what economists know. Normative economics is also analytical but goes beyond asking "What is?" to asking "What should be?". As such, it attempts to make explicit certain value judgments or preferences held by an individual, a group, or by society at large.

Positive economics can be related to the environment in several ways. First, it deals with the tastes and preferences of people in their role as "consumers" of goods and services. (Having already said that a good cannot be "consumed" in a physical sense, we should really say that people consume services which

may or may not be embodied in goods.) Why people prefer some services to others is a question best answered by psychologists. Economists base their analysis on the assumption that people derive something called "utility" or "want satisfaction" from the consumption of certain services. A large portion of positive economics, called demand theory, rests on this assumption. The essense of this theory is that people tend to select that bundle of services which will maximize their utility, subject to three constraints. The first is that the purchasing power of any person, no matter how rich, is not infinite. The second is that the knowledge of the utility which could be gained by each and every commodity is similarly limited. The third constraint, perhaps most directly related to current environmental issues, is that the consumer has no control over the availability or the prices of commodities.

Referring back to Figure 1, two general categories of services or commodities can be identified as having relevance to the behavior of people as consumers. In one category are all those products emanating from the "production sector" of the economy. In the other category are those characteristics of the natural environment which directly yield utility to people. In reality, of course, a gray area exists between the two categories: a river may yield utility because of natural characteristics although the activities of man are often reflected in the vista. The popular tendency today is to identify as "environment" those attributes of nature which yield utility directly. A broader interpretation of environment is in terms of "surroundings." In this context, man-made products are important elements of "environment." Indeed, the historical pattern of mankind has largely been one of altering or adapting to those elements of nature which threatened his safety, comfort, or very existence. Clothing, food, and shelter are certainly products of the "production sector" of a monetary economy which contribute to the "environment" of an individual.

A second means of viewing the relationships of "economics" and "the environment" is through the activities of the production sector of an economy. Positive economics is also helpful here, as it allows us to visualize the role of the producer as well as the consumer. The producer is viewed in positive economics as essentially a profit-maximizer, subject to contraints similar to those faced by consumers. In this case, the major constraints are (1) the existing technology for transforming inputs into outputs, and (2) the prices of those inputs which the producer buys and the price of the product which he sells.

The motivations and actions of both consumers and producers can be related, then, through the phenomenon of "exchange" in a monetary economy. Money provides the medium of exchange, utility forms the basis for consumer demands, and profit forms the basis for supplies of commodities by producers who sell them to satisfy their own desires as consumers. (Cold as it may seem to some, labor may also be viewed as a "commodity" in

this context.) A market is thus formed by virtue of "exchange" which ostensibly leaves both the buyer and the seller better off.

To this point, it may appear that the "economy" and "economics" are almost identical concepts. At an earlier point in history, this may in fact have been true. The discipline of economics can be traced back to the time of the Industrial Revolution, especially in England. The first economists, such as Adam Smith, developed their analytical concepts of economics by observing the emergence of a free-enterprise, capitalist economy. In fact, it is often argued that the discipline developed as an expression of admiration for a competitive laissez-faire economy. As the discipline has developed over the last two centuries, its adherents have come to be more critical observers of the marketplace as a resource allocator. Just as philosophy has ceased to be the handmaiden of religion, economics has ceased to be the handmaiden of the marketplace.

II. The Roots of Our Environmental Crises:

Definition and discussion of the key terms -- "economics," the "economy," and the "environment" -- allow us to delve more deeply into underlying causes for our environmental crises. At the risk of gross over-simplification, let us divide the causes into two categories -- "straw-men" explanations, and "root causes."

A. "Straw-men" Explanations:

One might, for example, say that technology is to blame for the current environmental crises. The effects of persistent pesticides such as DDT on humans and other animal life might be pointed to as an example of a technology which was not adequately understood at the time that DDT was first placed on the market. There is no doubt a real germ of truth in this explanation in that the nature of today's technology is so complex that it is extremely difficult or even impossible to determine the ultimate direct and residual effects of certain chemicals. The weakness of the argument is that it is futile to blame technology when people and social institutions are necessary to select and implement the technology!

A parallel explanation, then, is that people and social institutions are to be blamed for the environmental crises. Two variations are the "big business" theme and the "establishment" theme. The two might be related as follows: "big business" is exploitative and selfish, therefore it causes pollution, infiltrates the regulatory agencies, and eventually forms the "establishment."

The fallacy of our straw-men explanations is that they are simplistic, and as such, are necessarily broad and susceptible to internal inconsistencies. Consider, for example, a recent widely-read article on "The Historical Roots of our Ecological

Crises" by Lynn White, Jr., a noted historian (8). In this article, White develops the argument that our present environmental crisis has its roots in our Judeo-Christian heritage. To quote White's reasoning:

> "By gradual stages a loving and all-powerful God has created light and darkness, the heavenly bodies, the earth and all its plants, animals, birds, and fishes. Finally, God had created Adam and, as an afterthought, Eve to keep man from being lonely. Man named all the animals, thus establishing his dominance over them. God planned all of this explicitly for man's benefit and rule; no item in the physical creation had any purpose save to serve man's purposes. And, although man's body is made of clay, he is not simply part of nature; he is made in God's image.
>
> Especially in its Western form, Christianity is the most anthropocentric religion the world has seen" (8, p. 1205).

White further suggests that Christianity in the Western world destroyed pagan animism and made it possible for man to exploit nature while remaining indifferent to the feeling of natural objects. The implication is very clear to White:

> "More science and more technology are not going to get us out of the present ecologic crisis until we find a new religion, or rethink our old one" (8, p. 1206).

Although such a broad argument as this has some appeal, it is subject to internal inconsistencies. How, for example, does one reconcile the fact that this same Christian heritage, when linked with agrarian fundamentalism, stressed that man was indeed a "steward" of the land?

It is increasingly popular to place the blame for environmental degradation on <u>population growth and concentration</u>. There can be little doubt that these factors aggravate the situation, since they cause the number of potential human interactions to increase at an increasing rate. Garrett Hardin, a noted biologist, has stressed this theme in a recent article entitled "The Tragedy of the Commons" (3). Hardin has likened the historic and unquestioned freedom for individual family planning to the English "commons," wherein herdsmen seeking to maximize their individual gains brought about the inevitable destruction of the "commons." To quote Hardin:

> "If each human family were dependent only on its own resources; if the children of improvident parents starved to death; if, thus, overbreeding brought its own "punishment" to the germ line -- <u>then</u> there would be no public interest in controlling the breeding of families. But our society is deeply committed to the welfare state, and hence is confronted with another aspect of the tragedy of the commons.

> In a welfare state, how shall we deal with the family, the religion, the race, or the class (or indeed any distinguishable and cohesive group) that adopts overbreeding as a policy to secure its own aggrandizement? To couple the concept of freedom to breed with the belief that everyone born has an equal right to the commons is to look the world into a tragic course of action" (3, p. 1246).

Although Hardin's arguments are persuasive, I would suggest that his reasoning can best be placed within the context of a more powerful explanation. We turn now to this.

B. <u>"Root Causes"</u>:

A more basic explanation for the existence of environmental quality problems lies, I believe, in the failure of certain economic and social institutions to encourage or force participants in the marketplace to take into account the effects of their actions on third parties. The term "third parties" requires explanation. First, it may be singular or plural; particular individuals or entire societies may be adversely affected by market transactions of others. Secondly, the direct participants in the exchange process, i.e., the buyer and the seller, evidently gain from exchange or else they would not participate. Third parties, on the other hand, have no opportunity to reveal whether or not they would benefit from the exchange process between others. Since they do not have this opportunity, this is little reason to expect that gains enjoyed by some third parties will outweigh losses suffered by other third parties. In fact, the real implication for environmental quality is that the psychic and monetary costs suffered by third parties are, in the aggregate, quite large at the present time. Furthermore, there is reason to expect that the sum of these costs will increase over time.

This failure to take third party costs (and benefits) into account is usually referred to by economists as an "externality." That is, the side-effects are external to the buyer and seller as primary decision-makers. Until recently, the economics profession tended to view externalities as rather freakish and unimportant. Now, however, there is ample reason to believe that externality is a pervasive phenomenon, especially in an age of industrial development and population concentration.

The "economy," then, as structured by social rules and institutions, has to be held responsible for much of the current environmental crisis. On the other hand, the performance of our free-enterprise economy has to be regarded as somewhat paradoxical for the following reasons.

1. It has allowed U.S. society to attain a high level of goods and services emanating from the production sector. It has enhanced our "environment" if that term is taken in a very broad sense.

2. It has created both a technological superstructure second to none and a feeling that technology can solve any problem.

3. It has historically used the natural environment extensively to provide factors of production. Now that consumers have reached high levels of satisfaction with man-made goods and are turning to the natural environment as a direct source of utility, we find that these resources have deteriorated greatly in quality and quantity. We now have a decreasing scarcity of fabricated products and an increasing scarcity of products of the natural environment.

There are two important underlying reasons for externalities and the consequent inability of markets to adequately provide environmental services. The first is that third parties may not be allowed to intervene in market transactions which adversely affect them. The second is that third parties may not have adequate incentive to attempt to intervene. Let us treat these in turn, recognizing that they are highly related to each other.

The first has to do with a cherished tradition of individual freedom, especially as expressed through the social institution of private property rights. At an earlier point in time, the extent of these rights was much less circumscribed than at present. Buyers and sellers were, in the extreme, the only parties of consequence. Time and social experience have moved us away from this extreme position. The development of both statutory and common law has moved in the direction of recognizing the rights of third parties. In fact, one could make an argument that most of our present laws are aimed at reducing the magnitude of externalities, especially as related to "environment" in the broad sense.

As an example of where we are today in this evolution, the idea of "class action suits" is of particular interest with respect to environmental quality. To this time, the law has generally maintained that third parties bear the burden of proof of particular losses or injury. The growing recognition by the courts of the validity of class action suits is evidenced by a more common acceptance of the sufficiency of showing general injury to groups of which the person is a member.

The second cause for externality is that of insufficient incentives for third parties. Again, the notion of property rights is central to the issue. Often the definition of property rights is technically difficult. An optimum level of noise abatement could conceivably be reached if individual rights were clearly defined and a market for these rights were established. Drivers of sports cars, for example, might have to buy householders' permission to inject noise into their respective sound-spaces, or householders might have to pay the

drivers to get mufflers or cease driving noisy vehicles. Such markets do not usually exist and might be difficult, impossible, or very expensive to establish.

On the other hand, property rights may be definable but socially desired actions may not be taken because of the inability of an individual owner to exclude "free loaders." Here, private property rights may lack exclusivity. An area suitable for a public park has remained undeveloped near the author's home for several years. Cost considerations aside, an individual home-owner would not undertake such an investment because he could not tap other home-owners for a share of the derived benefits. Mancur Olson (6) refers to this as constiuting the "logic of collective action."

III. Toward Solutions to Environmental Problems:

In the section above, we suggested that a basic reason for existence of environmental quality problems lies in the absence of appropriate incentives for economic decision-makers. The general nature of suggested public policy follows directly from this diagnosis, i.e., one should work toward changing underlying institutions so that decision-makers are confronted with both the private and the social costs of their actions. The specific forms the public policy should take, on the other hand, are less readily apparent. One could discuss possible "solutions" in many ways. A common treatment would be to discuss policies according to the type of problem, e.g., water quality and air quality. Instead of taking this approach, the following is based on the nature of the decision-maker. The two basic types of decision-makers are (a) those in the private sector, i e., firms and consumers, and (b) those in the public sector. The two are closely related, to be sure.

A. Private Sector:

As a prelude to some possible approaches for coping with problems of environmental quality, it may be useful to spend some additional time discussing the nature of resource allocating mechanisms. The point of departure here is again the "economy."

Adam Smith, in writing The Wealth of Nations in 1776, coined the notion of the invisible guiding hand" of the marketplace, and thus left an indelible image in the minds of succeeding generations (7). Smith saw that the marketplace provided both an outlet and a discipline for the self-seeking interests of firms and consumers. In the context of modern society, however, it should not be taken to mean that results obtained in free markets are necessarily "good." Over time, at least four basic qualifications have been realized. These are (a) the possibility of imperfect competition, (b) the desirability of the pattern of income distribution which the market generates, (c) the possibility that some resources may not be employed, and (d) the possibility of a divergence between private and social costs due to externalities.

Faced with these short-comings, economists have usually suggested that remedies be devised to restore the essence of a competitive market. Faced with the problem of monopoly, they have urged anti-trust legislation. Faced with less than full employment, they have urged appropriate monetary and fiscal policies.

Why do economists continue to place considerable reliance on the ability of the marketplace to allocate resources? A capsule answer is that many view the marketplace as potentially capable of assembling a vast amount of information at a low cost. That is, a market is potentially capable of "economizing" with respect to information. For example, a centralized government with control over the means of production would want to know how many pairs of shoes to produce. It might also want to maximize the utility of the people, but this utility also depends on the consumption of commodities other than shoes. In order to operate efficiently, the central planner needs to know (a) how much utility consumers would derive from additional shoes, relative to more units of other commodities, and (b) the sacrifice in terms of foregone production of other commodities as a result of using scarce resources to make shoes. The current acclaim in Communist countries of the "Liberman system" is an indication that the market mechanism can be a useful means of obtaining this information.

What does this have to do with environmental quality? Allen Kneese's work in the area of water quality offers some imaginative insights (4). Kneese has written extensively on the idea of "effluent charges," whereby water polluters are forced to take into account the costs that would be imposed on others. The Ruhr Basin in Germany is pointed to as a region in which charges are levied on firms, based on the nature and volume of their waste products. Instead of asking a central authority to specify the nature and means of waste treatment, firms are encouraged by price incentive to consider alternative means of waste treatment.

This solution of substituting price incentive for governmental edict is no panacea for environmental quality problems, but it does illustrate the possible gains from imaginative use of the price system as a result allocator. Another application in natural resources is Krutilla's suggestion that compulsory flood plain insurance be considered as a partial substitute for public investment in flood control structures (5). In both examples, individual economic units are faced with the social as well as private costs of their actions.

The advantages of using the price mechanism in this regard can also be over-stated. In order to impose "effluent charges" on polluters, the proper level of charges must be determined. This involves a number of problems which are not easily answered, such as the foregone values of extra-market goods like recreation. Information on possible taxes and/or subsidies comes at a cost

which must be considered in public policy. Even so, imaginative use of the price mechanism has some potential. The work that Kneese and Krutilla have done is pioneering, and public policy of this nature is still embryonic. The major advantage is that you "hit them where it hurts," i.e., policy might be designed to utilize the price incentive system that our society recognizes and to which it responds.

B. Public Sector:

Many of the comments made above apply equally well to governmental bodies which function as firms in providing services such as waste treatment and disposal, recreation, and transportation. There is one alternative open to these "firms," however, which is discouraged in the private sector by antitrust laws. The formation of larger units of government for purposes of combatting special problems seems to be a slowly emerging trend. There are good economic reasons for encouraging regional, rather than local, approaches to many environmental quality problems. The primary reason behind this argument in water quality control appears to be the prospect of substantial economies of size in waste treatment. The Ruhr Basin system, described by Kneese, essentially treats one entire river which serves as a collector of effluent. This degree of stream specialization may not be desirable in our circumstance, but it does illustrate the possibility of obtaining a higher level of waste treatment per dollar of cost.

It must be admitted, of course, that public decision-makers will need to continue to grapple with many environmental problems where price incentives cannot be devised so as to allow private sector decision-making to function better. The bulk of public environmental policy is currently in this category, and will probably remain so for some time. Society has experimented with a variety of control measures, including waste discharge treatment requirements, receiving water standards, zoning, pesticide regulation, and automobile smog control devices. Even though the price system and the economy is not used in these control measures, the logic of the price system can still be used. Three propositions derived from this logic are relevant here.

1. "There is no such thing as a free lunch."

Nothing is free, although the monetary price of many environmental services is zero. They are of value, however, in that they yield utility to consumers who are unable to purchase them because markets do not exist.

2. "The degree of environmental quality desired by many people is not free."

Environmental protection will cost money, not just for sewage treatment plants and emission control devices, but for what

this money could have purchased. After all, public monies for environmental protection could instead be used to provide health and education services. If price incentives are used to force polluters to take externalities into account, it stands to reason that part of the added costs will be passed on to consumers.

3. "The question of who pays for environmental protection needs to be carefully considered."

The desire for a better natural environment stems largely from the upper-middle income type of person. Having reached a fairly high level of utility from man-made products, the appeal of environmental services is quite high. On the other hand, there are many other people in society who have not yet reached the same level of satisfaction from man-made products. If the effect of an environmental crusade would be to redistribute well-being from the less affluent to the affluent, surely this is a perversity which must be avoided in a democratic society.

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7. Smith, Adam, The Wealth of Nations, Henry Regnery Company, Chicago, Illinois.

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Additional References

Numerous popular publications available today are devoted to environmental questions. Most contain some discussion of economic issues, but often this discussion is quite superficial. For this reason, I have singled out the following as of special value in terms of their treatments of economic issues.

1. Joint Council on Economic Education, The Economics of Pollution, 1970.

An 18 page pamphlet, published by the Joint Council on Economic Education, 1212 Avenue of the Americas, New York, New York, 10036. Three sections are written by Dr. Harold Wolozin of the University of Massachusetts. One deals with why pollution is a special problem of production and consumption; a second surveys the difficulties of measuring and assigning costs of pollution. A third section analyzes measures to combat pollution.

Accompanying each article are teaching suggestions by Patricia R. Reilly of John Dewey High School, New York City. Mrs. Reilly, who is a Kazanjian Award winner for excellence in teaching economics, sets down instructional objectives, ideas for motivating students, strategies for analysis of pertinent questions, and tabular and graphic material for clarifying issues.

2. Barkley, Paul W. and David W. Seckler, Economic Growth and Environmental Decay, Harcourt Brace Jovanovich, Inc., 1972.

This recent paperback ($2.95) fills a void in that it examines the relationships between economic growth and environmental quality in a manner well suited to the lay reader. Only those economic tools are presented which are necessary for an understanding of the problems involved.

The book and the present paper are quite compatible in approach, as evidenced by Barkley and Seckler's comments in their Preface:

> "We hope to show how an economic system based on private decision-making processes leaves much opportunity for environmental decay--not necessarily through conscious effort of individuals--but through gaps in ownership patterns, lapses in incentives, and uncertainties regarding the future. Correcting these ills will not be easy, and the prescriptions found herein are, perhaps, only stopgap measures. The fact that the issues are carefully laid out for a reader's examination is tremendously important, however."